COLORADO
Department of Public Health & Environment

History of Arsenic Standards
Application of Water + Fish and Fish Ingestion Standards

Introduction

This document is a brief synopsis of the arsenic standards adopted by the Colorado Water Quality Control Commission for the Water Supply Use sub-classifications of Water + Fish and Fish Ingestion.

Basic Standards for Surface Water (Regulation #31)

The Commission's policy decision to apply Water + Fish (W+F) standards to all waters classified Aquatic Life 1 dates back to at least 1991. At that time, only organic chemicals had W+F standards. W+F standards were to be considered for Aquatic Life 2 waters on a case-by-case basis. (see Regulation #31, page 106).

In 1994, the concept of W+F standards was expanded to include metals in table 31.16. Only antimony and thallium were included at this time. (see Regulation #31, page 133)

In 2000, the human-health-based standards for organics were reconfigured to include a Fish Ingestion standard that didn't include the drinking water pathway. The policy about application of these standards was adjusted as well: W+F standards were to be applied automatically to waters with Aquatic Life 1 and WS classifications, FI standards were to be applied automatically to water with Aquatic Life Class 1 without WS. Such standards for Aquatic Life Class 2 waters continued to be considered on a case-by-case basis. (see Regulation #31, page 146)

In 2005, the Commission revised the W+F and FI standards where new information was available. One of the parameters that was included in this round was arsenic (see Regulation #31, page 173).

South Plate River Basin Standards (Regulation #38)

In March 1991, the Commission applied the policy of adopting W+F standards for Aquatic Life 1 classified waters. (see Regulation #38, page 110).

In June 2009, the Commission implemented changes that had been made in the Basic Standards in the South Platte basin. Arsenic W+F and FI standards were added at this time (see Regulation #38 page 216). There was no change to the automatic application of W+F to Aquatic Life 1, WS waters, however, because of the complicated nature of the arsenic standards, the applicable values were added to each segment rather than to continue to rely on picking out the relevant values from the tables in the Basic Standards.

COLORADO
Department of Public Health & Environment

(from the Regulation #38 Statement of Basis & Purpose)

For arsenic, each use (except recreation) has a different arsenic ("As") value, including Fish Ingestion (FI) and Water Plus Fish (W+F). In different combinations of uses, different values become the most limiting. In order to eliminate the confusion, the Commission added the operative value to the individual segments. The following matrix displays the most limiting arsenic criteria.

Most Limiting Arsenic Criteria Depending on the Possible Combinations of Uses and Qualifiers	
If the Use Classifications were:	**These Arsenic Standards were Applied (dissolved unless otherwise noted)**
Class 1 aquatic life, water supply	As(ac) = 340, As(ch) = 0.02(Trec)
Class 2 aquatic life (water + fish standards), water supply	As(ac) = 340, As(ch) = 0.02(Trec)
Class 2 aquatic life (no fish ingestion standards), water supply	As(ac) = 340, As(ch) = 0.02 - 10(Trec)
Class 1 aquatic life	As(ac) = 340, As(ch) = 7.6(Trec)
Class 2 aquatic life (fish ingestion standards)	As(ac) = 340, As(ch) = 7.6(Trec)
Class 2 aquatic life (no fish ingestion standards), agriculture	As(ac) = 340, As(ch) = 100(Trec)
Agriculture only	As(ch) = 100(Trec)
Water supply only	As(ch) = 0.02 - 10(Trec)

Other Regualtions

The Water + Fish arsenic standard was applied to the other river basins in the state in following sequence:

- June 2006 – San Juan River Basin (Regulation #34) and Gunnison River Basin (Regulation #35)
- June 2007 – Arkansas River Basin (Regulation #32) Rio Grande Basin (Regulation #36)
- June 2008 – Upper Colorado River Basin (Reg #33) and Lower Colorado River Basin (Regulation #37)

Recent Rulemakings

In December 2011, The Commission heard an emergency rulemaking for Upper South Platte River Segment 14 (Regulation #38). At this rulemaking, the Commission decided that since the technologically achievable arsenic level is less stringent than the calculated W+F criterion, the W+F criterion for segment 14 will be a hybrid, based on a range of 0.02-3.0 µg/L. The first number in the range is the strictly health-based value, based on the Commission's established methodology for human health-based standards that protect against the combined exposure of drinking water and eating fish. The second number in the range is the technologically achievable value of 3.0 µg/L. The Commission adopted this revision in the form of a temporary modification in recognition of the uncertainty regarding use-protective values and achievability. In August 2012, the Commission ratified the emergency action.

In April 2013, the Commission considered statewide temporary modifications for segments that had a permitted permitted discharger with a water quality-based effluent limit compliance problem existed and a Water + Fish arsenic standard (Regulations #32, #33, #34, #35, #36, #37 and #38). The adopted temporary modification is "As(ch)=hybrid". An explanation of the hybrid temporary modification and its expected implementation into control requirements, such as Colorado Discharge Permit System (CDPS) effluent limitations, is described in each regulation. The temporary modification allows for a temporarily less stringent application of the chronic arsenic standard in control requirements, such as CDPS permits, for both existing discharges and new or increased discharges. The expiration date of the temporary modification was set at 12/31/21 to allow for CDPS permits that are issued prior to the effective date of anticipated changes to the chronic arsenic standard in the 2016 Basic Standards Rulemaking to not have the temporary modification expire within the term of a permit.

The Division intends to address the uncertainty of the W+F chronic arsenic standard with respect to a technologically feasible level of treatment through a continued workgroup process, and propose a revised W+F chronic arsenic standards as part of the 2016 Basic Standards Rulemaking Hearing.

WQCC Policy 96-2

The following is an excerpt from the Commission's Policy 96-2, which describes the calculation of arsenic Water Supply and Water + Fish standards.

1. Statewide Standards and Table Value Criteria for Domestic Water Supply

   b. For carcinogens[1], a 10^{-6} incremental lifetime cancer risk level[2] is used in calculating table value criteria and statewide standards for domestic water supply. The concentration corresponding to a 10^{-6} cancer risk from drinking water, as contained in the Integrated Risk Information System (IRIS) and/or EPA health advisories, is used as the basis for the table value criteria and statewide standards. The Commission has opted not to adopt table value criteria and statewide standards for carcinogens that, due to EPA policy, have been assigned a MCLG equal to zero, and for these compounds the standard is set to the MCL.

   Equation 1-2: $\text{DWS/MCLG, } \mu g/l = \frac{\text{ILCR} \times 70 \times 1000\ \mu g/mg}{2 \times q1^*}$

   where:

[1] Carcinogens are considered to be those pollutants classified by EPA as Group A, known human carcinogens, or Group B, probable human carcinogens. The Commission has not adopted carcinogenicity-based criteria and standards for pollutants classified as Group C, possible human carcinogens, due to the inadequacy of the available data for this category of pollutants.

[2] Incremental lifetime cancer risk (ILCR) means the increased probability of cancer occurring beyond that experienced by an individual or population not exposed to the water in question; i.e., increased risk beyond background incidence.

ILCR[e]	=	incremental lifetime cancer risk factor
70	=	weight of an average adult, kg
2	=	daily drinking water consumption, liters/ day
q1*[3]	=	cancer slope factor

A 10^{-6} incremental lifetime cancer risk factor is used in the derivation of the table value or statewide basic standard.

...

2. Statewide Standards and Table Value Criteria for Water+Fish (Drinking Water and Consuming Fish)

Statewide standards and table value criteria for Water+Fish are developed in accordance with procedures specified by EPA criteria guidance promulgated under Section 304(a) of the federal Clean Water Act.

b. For carcinogens,

Equation 2-2: $W+F, \mu g/l = \frac{ILCR \times 70 \times 1000\ \mu g/mg}{q1^*[2 + (DFC \times BCF \times I/O\ Frac)]}$

where:

ILCR	=	incremental lifetime cancer risk factor
DFC	=	daily fish consumption, kg/day (0.0175 is the default value)
q1*	=	cancer slope factor, kg-day/mg
BCF	=	bioconcentration factor, liters/kg
I/O Frac	=	Fraction that is inorganic, For use where only the inorganic fraction is of concern. For arsenic I/O Frac = 0.30, other substances, I/O Frac = 1.0

A 10^{-6} incremental lifetime cancer risk factor is used in the derivation of the table value or statewide basic standard.

For arsenic

- bioconcentration factor (BCF) of 1 L/kg,
- fish intake (DFC) of 0.0175 kg/day, and that
- 30% of arsenic in fish tissue is inorganic (and is the reactive portion)
- cancer slope of 1.75 kg-day/mg,
- cancer risk of 10^{-6} (one in one million)
- body weight of 70 kg, and
- water consumption of 2 L/day.

---

[3] The cancer slope factor is an estimate of carcinogenic potency derived from animal studies or epidemiological data of human exposure. It is based on extrapolating high-dose levels over short periods of time to low-dose levels and a lifetime exposure period through the use of a linear model.


CDPHE
CO
COLORADO
Department of Public
Health & Environment